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ABSTRACT

The paper addresses three major concerns associated with incorporating microcomputers into educational settings: computer use, software selection, and hardware selection. Advantages of the computer in instructional settings are noted as well as its limitations. Staff is advised to select which of four applications is appropriate to their setting (the microcomputer as an object to be studied, as tool to help in one's work, as a teacher or tutor, and as a management tool). Software evaluation is considered in terms of external and internal evaluations. Practical aspects of hardware evaluation are offered, including costs and compatability. Five steps are outlined in the summary: (1) curricula needs must be identified; (2) a "goodness of fit" between identified needs and computer uses must be determined; (3) software which meets curricula needs must be identified; (4) identified software must be throughly evaluated; and (5) the application of basic consumer considerations should be used to purchase microcomputers and peripherals which will adequately run the selected software. A sample software evaluation form and a five-page reference list are appended. (CL)

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How School Systems Should Purchase Microcomputers:

The Software Evaluation Method

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Running Head: Software Evaluation Method

How School Systems Should Purchase Microcomputers:

The Software Evaluation Method

The National Center for Educational Statistics reports that in 1981 approximately 31,000 microcomputers were in use in the public school sector. This figure increased to approximately 325,000 microcomputers in 1983 and is predicted to reach about 1.6 million by 1985 (Bonner, 1984; Emmett, 1983). More than half the nation's schools have at least one microcomputer. Unfortunately, many schools have just that: one microcomputer. Emmett questions whether or not these figures translate into a "microcomputer revolution" taking place in the public school system (1983). Emmett's statistics from the 1981-1982 school year indicate that of the 45 million precollege students in the United States, less then five million students had access to a microcomputer during that year, with an average of nine hours of use per student for the school year. He claims that these figures hardly justify proclamations of a "microcomputer revolution".

However, for a profession that took about 200 hundred years to accept books after their introduction (Schilling, 1983) and a system that does not reward the development of technology to improve classroom teaching (Lindenau, 1984), the teaching profession and public school system are definitely undergoing some dramatic changes. Public education has responded positively to the President's Commission on Excellence in Education, "A Nation at Risk" and its proposed "five basics" for graduation from high

school which include computer science (Karoff, 1983). Clearly school systems are purchasing microcomputers in unprecedented numbers (Cohen & Schwartz, 1983; Power, 1983; Stallard, 1982; Taber, 1983). Administrators are no longer asking "if" or "when" computers are to be acquired (Power, 1983). Today's big question is "how":

1. How will our system choose the correct computer (Anderson & Senf, 1982)?
2. How will our system use computers (Anderson & Glowinski, 1982; Chandler, 1983; Grossman(b), 1983; Torgesen & Young, 1983)?
3. How cost effective are computers (Grossman, 1983)?
4. How can our system afford computers (Chandler, 1982)?

Curricula Needs Assessment

This paper will address the three major concerns associated with incorporating microcomputers into educational settings:

1. Computer use
2. Software selection
3. Hardware selection

The very first step of successful incorporation of the microcomputer into the educational process is the same essential component of desirable pedagogy, utilized in the incorporation of any effective teaching: educational aims need to be painstakingly translated into specific educational objectives (Abernathy, 1983; Rowntree, 1982;

Wheatley, 1983). Before any further steps are taken, the educators involved must first determine their needs (Collopy, 1983; Noland, 1984; Rubin, 1984) completely divorced from the question of computer use. The teachers need to specifically identify the skills their students require (Carrozzo, 1983), and then identify the areas needing improvement in conjunction with the problems or difficulties they foresee in reducing the gap between the skills their students possess and their students' predicted needs (Carrozzo, 1983; Collopy, 1983; Thompson, 1983). The skills and/or subjects needed to be taught then need to be prioritized from essential to optional and viewed not only in the context of immediate requirements, but also projected over at least a five year period of time (Abernathy, 1983; Collopy, 1983; Fleig, 1983).

Computer Use Assessment

Only when educational goals are clearly determined should the possible use of microcomputers be entertained. Even then, it is still too early to be considering brand names. One now needs to begin the process of determining if the use of microcomputers in fulfilling the previously defined curricula and/or instructional needs will potentially obtain more desirable results than ones obtained by more traditional instructional methods (Lalm, 1984). If the use of microcomputers does not promise increased learning potential, then the use of microcomputers may not be warranted in the fulfillment of that particular curricula need. Microcomputers should be acquired only if they help to solve educational problems (Collopy, 1983). Frequently well written learning objectives clearly suggest the use of a microcomputer medium. However, if the objectives are such that a computer will not facilitate attainment,

then the selection of any computer will be ineffective (Rowntree, 1982). Well constructed objectives will help determine the duties of the teacher, the duties of the students, and the instructional mediums necessary for both teachers and students to successfully perform their duties.

The classroom teacher is expected to be many things to many students at the same time: performer, subject matter expert, counselor, and record keeper to just mention a few . The computer can do some of these better, at least for some students (Schilling, 1983).

1. It can teach many things in many ways.
2. It can be very competitive or very cooperative.
3. It can be successfully used in structured as well as open classrooms.
4. It can be used with the "best teaching" methods as well as with the worst.
5. It can bore students as well as motivate them.
6. It can intimidate students as well as encourage them.
7. And it can threaten students as well as challenge them (Kleiman, 1984).

There are also many things the computer can not do for education (these lists are not meant to be exhaustive):

1. It can not decide what to teach.
2. It can not decide how to teach.
3. It can not choose the items and/or qualities to be emphasized by education.

4. It can not choose teaching methods and/or styles.
5. It can not choose how to organize schools and classrooms.
6. It can not choose the educational standards for students.
7. And it can not choose how to distribute resources (Kleiman, 1984).

The instructional staff needs to take the results of their "curricula needs assessment" and combine them with the capabilities of the microcomputer to develop the ways in which they will use the microcomputer. They will need to develop curricula that will integrate the computer into what they are already attempting to acomplish and simultaneously make full utilization of the availability of the microcomputer and its complete capabilities (Bonner, 1984; Emmett, 1983; Fleig, 1983). At present there are no real validated precedents for the efficient integration of the microcomputer into the established curricula alongside more traditional instructional procedures and/or materials (Bonner, 1984).

Four major potential instructional applications of the microcomputer are routinely identified (Duckenfield, 1984; Ewing, 1983; Ferret, 1983; Hagen, 1984; Katz, 1983; Karoff, 1983; Lahm, 1984; McClellan, 1984; O'Malley, 1984; Taber, 1983; Wheatley, 1983):

1. The microcomputer as an object to be studied
    a. computer programming
    b. problem solving
2. The microcomputer as a tool to help in ones work

a. statistical analysis

b. word processing

c. control of laboratory instruments

d. data base manipulation and searching

e. communication network

f. graphic use in the arts

3. The microcomputer as a teacher or tutor

a. drill and practice

b. tutorial programs

c. curriculum oriented games (learning games)

d. simulations

e. logic and problem solving

4. The microcomputer as a management tool

a. student schedules

b. student academic records

c. student attendance records

d. student test scores

The instructional staff needs to select which of the above uses of the microcomputer is/are appropriate for their particular classroom, school building, and/or school system (Fleig, 1983). This paper will not make any attempt to evaluate the potential uses of the microcomputer. It needs to be a local decision, in order to help insure that the technology will serve legitimate instructional purposes (Collopy, 1983; Fleig, 1983; Fritz, 1984; Rowntree, 1982; Rubin, 1984).

Software Evaluation

Once the needs for and uses of the microcomputer are defined, they need to be clearly communicated in "plain English", not one's newly acquired "computerese", to software vendors (Spokony-Smith & Smith, 1984). The careful selection of software is an extremely critical procedure that can not be taken lightly. In the final evaluation, it is the software purchased that will actually determine the use and effectiveness of your microcomputers in the instructional process (Fleig, 1983). Currently, a major impediment faces the unwary software purchaser. There is more "poor" software available than "good" software (Burke, 1984; Lindenau, 1984; Thro, 1983). Additionally, current software is "machine specific". Much of it will only operate on one or possibly a few types of the more than 200 brands of microcomputers currently available. Because of this situation, it is imperative that educators bring together the identified curricula needs and the identified microcomputer uses with their pedagogical training to select appropriate software before a decision on microcomputer brand and/or model is made.

Software is not only "machine specific", but each program is also limited to a specific purpose (Horn, 1983). At present, instructional software is a disordered array of disconnected activities which are not integrated into the curriculum (Emmett, 1983). One possible solution to this nightmare might be to have educators write their own programs. On the surface this can be a very appealing thought, until one considers the skills and time allotments required to produce a useful program. First, the teacher

would need to be proficient in a computer programming language or authoring language. And second, the teacher would require between 200 to 300 hours of programming time to produce a useful one hour instructional program (Emmett, 1983; Kontos, 1984). The teacher-would-be-programmer does not have the time to produce original programs. Software needs to be purchased. In order to purchase useful software, one needs to preview and evaluate it before purchase (Abernathy, 1983; Boyle, 1984; Christen, 1984; Edwards, 1983; Glassman, 1984; Lahm, 1984).

The user must accept the responsibility for demanding educationally sound programs through selective purchasing (Lahm, 1984). Only programs that have been exhaustively evaluated and found to be acceptable should ever be purchased (Abernathy, 1983; Appell, 1984; Boyer, 1984; Burke, 1982; Edwards, 1983; Glassman, 1984; Houston, 1984; Poelings II, 1984). Educators need to know prior to purchase that the software possesses educational value and that it satisfies an existing curricula need. Glassman recommends that failure to evaluate before purchase should be one of fifteen reasons to reject the purchase (Glassman, 1984). Two basic methods of software evaluation are available to prospective purchasers:

1. External reviews

2. Internal reviews

External Evaluations

Many educational journals and computer periodicals publish reviews of educational software programs. While these reviews may be used as potential screening devices to help sift through the large number of programs already available to educators, this method of evaluation presents some complications which must be considered.

1. Is the version reviewed the same as the one you plan to purchase?
2. What is the educational credibility of the reviewer?
3. What is the technological credibility of the reviewer?
4. How subjective is the review?
5. Are the curricula needs considered in the review the same as yours?
6. Are the users considered in the review the same as yours? (Taber, 1984)

A perfect match between the needs of the reviewer and potential buyers is very unlikely. Therefore, external reviews should only be used as a cursory means of identifying potential programs worthy of indepth review by the intended purchaser (Appell, 1984).

Internal Evaluations

Present software evaluation and acquisition are subjective processes. The selection and evaluation criteria need to be rigorously and behaviorally defined (Boyle, 1984). The most widely accepted method of operationalizing this concept has been through the development and use of software evaluation forms (Abernathy, 1983; Glassman, 1984; Kayser & King, 1984; Taber, 1984). Varying amounts of technological,

motivational, and pedagogical criteria have been summarized and placed in a check list format (Boyle, 1984; Fleig, 1983; Katz, 1983; Kayser & King, 1984; Kontos, 1984; Lahm & Levy, 1984; Rosenthal, 1984; Taber, 1984; Thro, 1983). Unfortunately, many of these instruments have sacrificed completeness and clarity for brevity (Abernathy, 1983). Software selection is a long-term, expensive commitment that must not be entered into hurridly. (Houston, 1984). Glassman states that software needs to be evaluated a minimum of three times before a decision to purchase is considered (Glassman, 1984). The total program needs to be examined, preview disks are not sufficient. If at all possible, it should be evaluated in the same environment in which it will be used (Kayser & King, 1984). Preview labs and/or software dealers willing to set up their equipment identical to your configuration (or intended configuration), supply an acceptable second choice (Edwards, 1983).

The software evaluation form selected should possess the following characteristics (see appendix A):

1. Request sufficient program background information to facilitate a purchase.
2. Present items which should indicate immediate rejection of the program.
3. Make provisions for the consideration of internal curricula needs.
4. Make provisions for the consideration of user population needs.
5. Make provisions for evaluating user conditions.
6. Make provisions for evaluating instructional methods employed.
7. Make provisions for evaluating computer presentation.

Educators can not afford to take short cuts. They must carefully select software that compliments their curriculum, is pedagogically sound, and is technologically sound. In order to do this, the software needs to be thoroughly and objectively evaluated before a decision to purchase or reject is made.

Hardware Evaluation

If the curricula needs assessment, the computer use assessment, and the software evaluation are completed in that order; the hardware evaluation procedure becomes relatively simple. Computer software is presently, and for the near future will remain, "machine specific". The software selected will dictate the brand of microcomputer required and also the peripherals required. It may seem simplistic, but the majority of effort expended during the process of selecting microcomputers should be divorced from the actual comparison of name brands and/or models. The identified needs and uses will identify the software required, which in turn, will limit the number of different machines from which to choose. From this "software dictated", some very practical considerations should help insure satisfaction with the microcomputer purchase.

One should select a machine that adequately runs the selected software; is currently available; and is supported by the manufacturer (Burke, 1984). Increased longevity of use may be obtained by identifying a company that enjoys the reputation of maintaining compatability when newer models are introduced. Also, the number of software titles available for a particular line of computer may sometimes be a valuable

gauge of a company's soundness. Software authors will attempt to write programs for machines produced by companies capable of maintaining support for their microcomputers.

Ultimately the costs involved must be considered. Limited budgets manadate adherence to the "software evaluation method". If the instructional goal is identified as computer programming instruction, an inexpensive microcomputer with 3K memory would meet the stated need. While the purchase of a very expensive, larger memory microcomputer better suited for computer assisted instruction would be impressive, it could also be economically unwarranted (McLeod, 1983).

There is some evidence which suggests that school systems selecting fewer brands of microcomputers have moved more smoothly and quickly towards computerization. However, this should not deter the use of the "software evaluation method" in the selection of microcomputer brands and/or models. Obviously, machinery which successfully facilitates the attainment of specified goals will be valued and, more importantly, used (Burke, 1984). It is the actual use of the computer which will insure satisfactory computerization.

Summary

The "software evaluation method" requires five steps:

1. Curricula needs must be identified

2. A "goodness of fit" between identified needs and computer uses must be determined
3. Software which meets curricula needs must be identified
4. Idnetified software must be thoroughly evaluated
5. The application of basic consumer considerations should be utilized in the purchase of microcomputers and peripherals which will adequately run the selected software.

That microcomputers should not be purchased from the top down should be glaringly obvious (Chorover, 1984). Administrators and/or policy makers can not choose hardware and then expect their teachers to figure out a way to make it work, simultaneously mandating that the system be integrated into the existing curriculum! It is an inefficient, expensive, backwards, and demoralizing approach to introducing microcomputers into the school system.

The microcomputer is a tool. Like most tools, the right one is necessary to do the job correctly and efficiently (Collopy, 1983). A sledge hammer is not needed to hang a picture! Any handyperson will attest that choosing the right hammer begins with assertaining that something needs to be hit. Clearly knowing what needs to be hit, how hard it needs to be hit, and who will do the hitting, make for better hammer selection. The microcomputer is no different. In order to select the appropriate microcomputer, one needs to know exactly what needs to be done, what materials are to be used (software), and the characteristics of the individual to be doing the task (using the microcomputer).

Like any other tool, a microcomputer without a need or use will simply collect dust. While it may be an interesting toy for some, its value and use as a teaching aid will not be realized if it is purchased without a well planned purpose in the existing curriculum.

The actual selection of a microcomputer should be a relatively simple operation if the necessary pedagogical considerations which guide the introduction of any medium into the classroom are followed. Technically speaking, educator's should never experience "analysis paralysis" due to the continuous comparison of hardware specifications (Freifeld & Engelmayer, 1983). Educators should do what they are trained to do; what they are good at! They should identify educational shortcomings, identify remedies, and evaluate the materials needed to apply the remedies. This is the process which will insure the introduction of appropriate technology into the classroom.

APPENDIX A

THE TROY INSTRUCTIONAL SOFTWARE EVALUATION FORM

ROBERT J. EVANS

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A. BACKGROUND INFORMATION

1. Program Title _____

   _____.

2. Author(s) _____

   _____.

3. Publisher _____

   _____.

4. Cost _____

5. Instructional Area(s) _____

   _____.

B. VETO ITEMS

____ 1. Program will not run on hardware configuration.

____ 2. Program uses incorrect grammar.

____ 3. Program uses incorrect spelling.

____ 4. Program uses demeaning, degrading, and/or inappropriate responses.

____ 5. Program suggests bias for or against any particular group.

____ 6. Program crashes and/or its performance is unreliable.

____ 7. Program rewards student for incorrect responses.

____ 8. Program allows incorrect responses to remain on screen without correction.

____ 9. Program does not allow the sound to be turned off.

C. CURRICULUM OBJECTIVES

1 2 3 4 5 1. Program meets priority objective number one.

1 2 3 4 5 2. Program meets priority objective number two.

1 2 3 4 5 3. Program meets priority objective number three.

1 2 3 4 5 4. Program meets priority objective number four.

1 2 3 4 5 5. Program meets priority objective number five.

D. APPROPRIATENESS FOR USER POPULATION

1 2 3 4 5 1. Program written at acceptable reading level.

1 2 3 4 5 2. Program written at acceptable vocabulary level.

1 2 3 4 5 3. Program written at acceptable language level.

1 2 3 4 5 4. Program written at acceptable cognitive reasoning level.

1 2 3 4 5 5. Program written at acceptable interest/experience level.

E. USER CONDITIONS

1 2 3 4 5 1. Degree of independent use by user.

1 2 3 4 5 2. User help cues appear on the screen.

1 2 3 4 5 3. User can quit a lesson at convenient points and begin again at the same point.

1 2 3 4 5 4. User can bypass or review instructions when repeating lessons.

1 2 3 4 5 5. User progress record stored on disk.

1 2 3 4 5 6. User progress record can be printed.

1 2 3 4 5 7. Time for user to complete a section is acceptable.

1 2 3 4 5 8. Responses are personalized.

F. PEDAGOGICAL CONSIDERATIONS

1 2 3 4 5 1. New concepts presented from simple to more complex.

1 2 3 4 5 2. One instructional concept presented per computer screen.

1 2 3 4 5 3. Practice items for new information.

1 2 3 4 5 4. Clearly defined lesson objectives defined.

1 2 3 4 5 5. Information provided on evaluation procedures.

1 2 3 4 5 6. Users are challeged to think/use information presented.

1 2 3 4 5 7. Brief appropriate feedback responses used.

1 2 3 4 5 8. Diagnostic test used to adjust lesson presentation.

G. COMPUTER SCREEN DESIGN

1 2 3 4 5 1. Screen format is consistent throughout the lesson.

1 2 3 4 5 2. White text on a black background is used for reading text.

1 2 3 4 5 3. Size and placement of text appropriate for user.

1 2 3 4 5 4. Directions are consistent throughout lesson.

1 2 3 4 5 5. Titles are consistent throughout the lesson.

References

Abernathy, S. Locating and selecting educational software. Peelings II, 1983, 4, (7), 18-22.

Anderson, D.O. & Glowinski, D.J. Effective use of computer-managed instruction program. Journal of Learning Disabilities, 1982, 15, 555-556.

Anderson, D.O. & Senf, G.M. LDsCAN JLD's new learning disabilities courseware assessment network. Journal of Learning Disabilities, 1982, 15, 624-625.

Appell, L.S. & Hurley, K.M. Individualizing instruction with microcomputer software. Focus on Exceptional Children, 1984, 16, (5), 1-12.

Bonner, P. Computers in education: Promise and reality. Personal Computing, 1984, 9, (8), 64-77.

Boyer, E.L. Education's new challenge. Personal Computing, 1984, 8, (9), 81-85.

Boyle, B. Software performance evaluation. Byte, 1984, 9, (2), 175-188.

Burke, R.L. (1982). CAI Sourcebook. Englewood Cliffs, N.J.: Prentice-Hall, Inc.

Burke, R.L. Selecting micros for schools. Electronic Education, 1984, 3, (7), 18 & 23.

Carrozzo, G. Teaching the basics with basic computers. Educational Computer, 1983, 3, (5), 54-57.

Chandler, H.N. & Schwartz, T.A. The use of microcomputers in teacher training. Journal of Learning Disabilities, 1983, 16, 300-302.

Chorover, S.L. Cautions on computers in education. Byte, 1984, 9, (6), 223-226.

Christen, K. & Michel, D. Electronic Learning's national directory of software preview centers. Electronic Learning, 1984, 3, (5), 68-70,100-110, & 112.

Cohen, S.B. & Schwartz, T.A. The use of microcomputers in teacher training. Journal of Learning Disabilities, 1983, 16, 300-302.

Collopy, D. Getting the right stuff. Personal Computing, 1983, 7, (11), 139-147.

Duckenfield, C. Computer literacy-crisis or false alarm. Electronic Education, 1984, 3, (5), 35.

Edwards, M.D. Snagging the perfect program. Teaching, Learning, Computing, 1983, 1, (1), 52-57.

Emmett, A. American education: The dead end of the 80's. Personal Computing, 1983, 7, (8), 96-105.

Ewing, E. An educational challenge for software. Peelings II, 1983, 4, (7), 24-25.

Ferret, J. Literacy beyond the one-shot scheme. Teaching, Learning, Computing, 1983, 1, (1), 124-126.

Fleig, C.P. Clearing up computer confusion. Teaching, Learning, Computing, 1983, 1, (1), 34-43.

Fritz, E. Teachers learn to love computing. A+, 1984, 2, (1), 94-105.

Glassman, E. "Software Evaluation" in Microcomputer Applications in Special Education: A Training Manual for Special Education Teacher Educators. Unpublished Manuscript, Reston, VA: Project RETOOL, Teacher Education Division of The Council for Exceptional Children.

Grossman, R.P. Online. Journal of Learning Disabilities, 1983, 16, 303-305.

Grossman(b), R.P. Online. Journal of Learning Disabilities, 1983, 16, 178-179.

Hagen, D. (1984). Microcomputer Resource Book for Special Education. Reston, VA: Reston Publishing Company, Inc.

Horn, C.J. & Finn, D.M. Sources of Computing. Focus on Exceptional Children, 1983, 16, (2), 1-16.

Houston, J. Don't bench me in. Byte, 1984, 9, (2), 160-164.

Karoff, P. Education's latest call to arms. Teaching, Learning, Computing, 1983, 1, (2), 16-17.

Katz, E.L. Microcomputers: A course of study for gifted students. Focus on Exceptional Children, 1983, 15, (6), 1-16.

Kayser, R. & King, G. 7 steps to buying better software. Electronic Education,1984 3, (6), 14 & 56.

Kleiman, G.M. Potentials and limitations. Compute, 1984, 6, (2), 120-121.

Kontos, G. Cost-effective teacher-made quality CAI - a fallacy. Electronic Education, 1984, 3, (8), 23 & 35.

Lahm, E.A. & Levy, S.A. "Microcomputers for management and instruction" in Microcomputer Applications in Special Education: A Training Manual for Special Education Teacher Educators. Unpublished Manuscript, Reston, VA: Project RETOOL, Teacher Education Division of The Council for Exceptional Children.

Lindenau, S.E. That's what it's supposed to do. Electronic Education, 1984, 3, (7), 40-41.

McLeod, A. Step into my laboratory. Teaching, Learning, Computing, 1983, 1, (2),

44-48.

McClellan, E. (Ed.). (1984). Microcomputer Aplications in Special Education: A Training Manual for Special Education Teacher Educators. Unpublished Manuscript, Reston, VA: Project RETOOL, Teacher Education Division of The Council for Exceptional Children.

Miller, L. (Ed.). (1983). Courseware Standards. Chicago: Bell & Howell Company.

Noland, J. Buying that first computer and printer and software and ... . Electronic Education, 1984, 3, (6), 19 & 50.

O'Malley, C. A buyer's guide to educational science software. Personal Computing, 1984, 8, (9), 94-115.

Peelings ratings. Peelings II, 1984, 5, (1), 5.

Power, J. Do computers byte? NEA Today, 1983, 1, 4-5.

Radin, S. & Lee, F. (1984). Computers in the Classroom. Chicago: Science Research Associates, Inc.

Rosenthal, S. Pedagogical programming. A+, 1984, 2, (9), 15-18.

Rowntree, D. (1982). Educational Technology in Curriculum Development, 2nd Ed. London: Harper & Row.

Rubin, C. How to buy a personal computer. Personal Computing, 1984, 8, (8), 108-120.

Schilling, S. Incentives and barriers to private sector involvement in public schools: A corporations perspective. Educational Computer, 1983, 3, (5), 42-45.

Spokony-Smith, M. & Smith, R. Getting the best software support. Electronic Education, 1984, 3, (6), 23 & 50.

Stallard, C.K. Computers and education for exceptional children: Emerging

applications. Exceptional Children, 1982, 49, 102-104.

Taber, F.M. (1983). Microcomputers in Special Education, Selection and Decision Making Process. Reston, VA: The Council for Exceptional Children.

Thompson, J.T. Competing for computer dollars. Teaching, Learning, Computing, 1983, 1, (1), 77-79.

Thro, E. You, your kid, and your Apple. A+, 1983, 1, (2), 109-119.

Torgesen, J.K. & Young, K.A. Priorities for the use of microcomputers with learning disabled children. Journal of Learning Disabilities, 1983, 16, 234-237.

Wheatley, G. Designing a computer education program for your school. Educational Computer, 1983, 3, (5), 51-53.